(19) FEDERAL REPUBLIC OF GERMANY
GERMAN {*SEAL*} PATENT OFFICE

(12) **Utility Model** **U1**

(11) Register Number	G 94 14 689.6			
(15) Main Class	F21K	7/00		
Subclass(es)	F21S	1/00	H01K	1/46
	H01L	27/15	H05B	37/02
	F21Q	3/00	G08B	5/38
Additional Information	// G08G 1/09, B61L 9/04, G09F 13/04, B64F 1/20			
(22) Application date	September 10, 1994			
(47) Registration date	December 15, 1994			
(43) Publication date in *Patentblatt*	February 2, 1995			
(54) Title	Multi-Light-Emitting Diode			

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Interest in licensing declared (nonbinding statement)

Specification

Multi-Light-Emitting Diode

The present invention relates to an apparatus for generating colored light.

Wherever colored light must be generated, multi-light-emitting diodes are increasingly used in place of small incandescent lamps. In these known multi-light-emitting diodes, a plurality of individual light-emitting diode crystals are mounted in one package. In this way, the light-emitting area is increased in comparison with a single light-emitting diode.

For this purpose the individual crystals are arranged in such a way that their associated angles of radiation overlap somewhat. Because of the small number of individual crystals and the slight overlapping of the angles of radiation, only small luminous fluxes are achieved.

Known multi-light-emitting diodes are therefore only able to replace small incandescent lamps.

A further disadvantage of known multi-light-emitting diodes is their small angle of radiation. For this reason, known multi-light-emitting diodes are only able to radiate their light in a plane and not into three-dimensional space like a conventional incandescent lamp.

The object of the invention identified in Claim 1 is to create a multi-light-emitting diode that has the luminous flux and the angle of radiation of a large incandescent lamp.

This object is achieved with the features cited in Claim 1.

With the invention, multi-light-emitting diodes are able for the first time to replace commercial large incandescent lamps when colored light must be generated. In this way, all the advantages that light-emitting diodes exhibit over incandescent lamps (longer life, mechanical strength, lower power consumption) are realized in installations and devices that have heretofore been operated with large incandescent lamps. These include, in particular, use in aviation hazard lights, signal towers, and traffic control lights in highway, and rail and air traffic.

It must be noted that this service is made possible not only by the simple increase in the number of crystals but also by the spherical arrangement of the crystals. Angles of radiation of 270° are required for aviation hazard lights and signal towers.

A further advantage of the invention is that the color filters that are needed to filter out a certain color from the full spectrum of light that is radiated by an incandescent lamp are superfluous because light-emitting diodes emit their light directly in color. The omission of these color filters is also a reason why the multi-light-emitting diode underlying the invention has a better efficiency than an incandescent lamp with color filter. Specifically, the color filter holds back more than one-third of the luminous flux radiated by the incandescent lamp.

An advantageous embodiment of the invention is identified in Claim 2 and Claim 3.

The development according to Claim 2 makes possible a still higher luminous efficiency, so that the efficiency of the multi-light-emitting diode is markedly improved. Further advantageous embodiments of the invention are identified in Claim 4 to Claim 14.

The development according to Claims 4 to 14 makes it possible to build the multi-light-emitting diode underlying the invention into the various installations and devices without any need for conversion of the installations and devices.

An exemplary embodiment of the invention is explained with reference to Figure 1 to Figure 5, in which:

Figure 1 shows the multi-light-emitting diode in side view.

Here reference character (1) denotes one of the many light-emitting diodes rigidly mounted in sphere (2). A standard Edison threaded base (3) is located on the sphere.

Figure 2 shows the pulse-width-modulation circuit for light-emitting diodes on a 230 V line voltage.

Here diodes (V_1-V_4) rectify the line current. The pulsating direct-current voltage supplies a number of light-emitting diodes (V_n). The number of light-emitting diodes is dictated by the desired luminous flux. The control unit is supplied with 12 V via dropping resistors (R_1) and (R_2) and Zener diode (V_5) and isolated by diode (V_6). (C_1) serves as the charging capacitor. A differential amplifier (V_7) serves to drive power MOSFET (V_8). Variable resistance (R_6) serves to produce the reference voltage at the inverting input of (V_7). In order to synchronize the output pulse with the highest amplitude, part of the pulsating direct current voltage is led via voltage divider (R_3, R_4) to the non-inverting input of (V_7). When the voltage drop across (R_3) rises above the value of the reference voltage in the rising edge, (V_7) acts via (R_5) to enable MOSFET (V_8) so that a current can flow via light-emitting diodes (V_n).

When the voltage drop across (R_3) falls below the reference voltage in the falling edge, (V_7) disables MOSFET (V_8).

Figure 3 shows one row of light-emitting diodes extracted from sphere (2) of Figure 1 as well as the mode of functioning of the invention.

Here rectifier (8) is supplied with line voltage via the contacts in base (3). The rectifier in turn supplies light-emitting diode (6) and those that follow. Terminals (7) and (9) lead to the remaining light-emitting diodes, not depicted here. In operation, light-emitting diode (5) radiates a colored light into angle of radiation (4). The other light-emitting diodes behave in a corresponding fashion so that angle of radiation (4) is overlapped by a plurality of angles of radiation of nearby light-emitting diodes. The luminous flux is correspondingly enhanced by this overlapping of a plurality of light-emitting diodes and has a value severalfold greater than that of an individual light-emitting diode. In addition, the angle of radiation is increased severalfold.

Figure 4 shows the angle of radiation of a known multi-light-emitting diode.

Here it is striking that the angle of radiation of the middle light-emitting diode is intersected by only two nearby light-emitting diodes. In addition, the aggregate angle of radiation is no greater than that of the individual light-emitting diode.

Figure 5 shows the angles of radiation and the aggregate angle of radiation of the multi-light-emitting diode underlying the invention.

Here angle of radiation (10) of one light-emitting diode is overlapped by many nearby ones. As a result of the spherical arrangement of the light-emitting diodes, colored light can be radiated into an aggregate angle of radiation that corresponds to that of an incandescent lamp even though each individual light-emitting diode has only a small angle of radiation.

Claims

1. Multi-light-emitting diode characterized in that the light-emitting semiconductor crystals are spatially arranged such that they exhibit a luminous flux and an angle of radiation or spatial angle of radiation that corresponds to that of commercial large incandescent lamps.

2. Multi-light-emitting diode according to Claim 1, characterized in that the light-emitting semiconductor crystals are operated in pulse mode.

3. Multi-light-emitting diode according to Claim 1 and Claim 2, characterized in that the pulse circuit is situated in the package or in the base of the multi-light-emitting diode.

4. Multi-light-emitting diode according to Claim 1, characterized in that the multi-light-emitting diode is fitted with an E27 base.

5. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with an E14 base.

6. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a BA20d base.

7. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a BA20s base.

8. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a BA15s base.

9. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a BA15d base.

10. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a G4 base.

11. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a PKX22s base.

12. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a GY6.35-15 base.

13. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a K23d base.

14. Multi-light-emitting diode according to Claim 1, characterized in that the multi-LED is fitted with a KX23d base.